METHODS OF ORIENTATION IN DRAGON-FLY LARVÆ

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Most terrestial insects orient themselves through vision, and most of them take advantage of the direction of light rays. Although other factors may influence the direction in which a given individual will travel, the visual, and possibly the olfactory, senses seem to be those chiefly utilized in maintaining a direct path. The only studies of a complete nature relating to this phenomenon in aquatic insects were made by Holmes (1905).

In the following experiments, the larvæ of *Anax junius* and some species of Aeschna were employed. Two larvæ were taken from the water, and the left eye of one insect and the right eye of the other covered with asphaltum. As soon as the asphaltum hardened they were put back into the water for about an hour. They were then removed and placed on a sheet of white paper. Their courses were traced with a pencil as they crawled. Ten such tracings were taken at one time; the animal was then placed in the water and allowed to rest. Thirty tracings in all, were taken for each of the two insects. The animal always turned toward the side with the covered eye. Often, after a few trials, the paths were almost straight; showing that habit tended to overcome the turning. These experiments were conducted in diffuse daylight.

Other experiments were tried with a beam from a 500 watt bulb. A larva with the left eye covered was placed at right angles to the beam and to the left of its source. In twenty-one trials it turned five times to the left, eight to the right, four times it followed a straight course, and finally turned four times to the right. On the following evening it turned seven times to the left, eighteen times to the right, once it took an irregular course, and once turned to the right. Two evenings later it first followed a straight course once, turned six times to the left, once followed a straight course, and finally turned seven times to the right. On the same evening, this insect was tried facing the light. Once it followed a

straight course, once turned to the left, again moved in a straight course once, turned twice to the right, to the left once, moved straight ahead once, turned to the right once, and resume the straight course five times. An insect with the right eye covered entered the light at right angles and at the left of its source. This larva turned to the right twice, took one irregular path, turned to the right once, to the left twice, to the right once, and to the left twenty-one times. When facing away from the source of light, it first followed a straight course, and then turned to the left twenty times. Facing the light, it turned always to the left.

Observations based on a study of these larvæ in their natural habitat or in aquaria gives some clue to the above irregularities. The insects are strongly thigmatropic. When a number of them are put into a vessel containing nothing but water, they will cling to one another until a great mass of intertwined insects is formed. This mass is not easily broken by the addition of chemicals, but very warm water will scatter the larvæ. Normally, these larvæ will seek out small sticks or the stems of plants and cling to such objects. Usually the entire ventral surface of the insect is in contact with this substratum, and the legs surround it in a close embrace. This brings the long axis of the insect's body parallel to the object upon which it rests.

The revolving disc that Dolley (1916) used so successfully in his experiments on *Vanessa antiopa* had no influence on the young dragon-flies, either in or out of the water. The nature and direction of light was a little more effective. Among aquatic insects the tactile sense seems to be only a shade less important than vision, and in may cases even more important. Anax and Aeschna larvæ orient primarily through contact stimuli. The influence of vision in orientation is secondary.

Literature.

Dolley, W. L.

1916. Reactions to light in the mourning-cloak butterfly, *Vanessa antiopa*. Jour. Exper. Zool. XX, p. 357.

Holmes, S. J.

1905. The reactions of Ranatra to light. Jour. Comp. Neur. and Psych. XV, No. 4.

NEW NAME FOR ODYNERUS CLYPEATUS ROBERTSON.—On account of *Odynerus clypeatus* Saussure 1852, this is changed to *Odynerus bradleyi* Robertson.—Charles Robertson, Carlinville, Illinois.